Introduction to Urban Drainage

Design Manual
Chapter 4
Drainage

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This part of Chapter 4 (Sections 4A-1 to 4A-9) provides guidelines for designing urban drainage systems (storm sewers). These guidelines are primarily for use with the interstate and primary road systems in Iowa's urban areas. Note that these guidelines are not necessarily policies: the designer should use sound engineering judgment, including technical and economic analysis, in applying the guidelines to any given situation. The Design Engineer and the Bridges and Structures Engineer will provide guidance for special and unique designs and will clarify any requirements which seem unclear, contradictory, or unnecessary.

Many other sections in this manual explain a situation or procedure that can be understood without knowing what is in the preceding sections (each section stands alone). However, the sections in this chapter fit together to describe major steps in the design of a storm sewer (they do not stand alone). Thus, the designer will not, for example, be able to understand how to choose and locate intakes (Sections 4A-5 and 4A-6) without first understanding the Rational Method (Section 4A-4). Experienced designers may be able to skip sections when they already know how to do something, but those unfamiliar with urban drainage design should read the sections in the order in which they appear.

The remainder of this section (4A-1) describes sources of information needed during the design process and provides a series of design standards. Much of this information can also be found at appropriate locations throughout the chapter.

Drainage Information Sources

Drainage information can come from many different state, federal, and local offices. A number of different jurisdictions may be involved with the design of a single drainage system, depending on the size and location of the project. The more information that is available to the designer, the better the final design will be. However, a lack of information may result in an unsatisfactory drainage system design.

In the Office of Design, the Preliminary Survey Section and Photogrammetry are the two primary sources of information. Preliminary Survey provides the basic survey information for the project including

- plan and profile sheets,
- 10 scales (250 scales in metric),
- 20 scales (500 scales in metric),
- cross sections,
- locations and elevations of existing storm sewer,
- locations of existing utilities.

Preliminary Survey can also provide drainage plats and utility plats for the project. Photogrammetry can provide topography maps, quad maps, and aerial photos of the project.

The city where the project is built may provide

- zoning plans,
- planning maps,
- future street and storm sewer plans,
- drainage studies,
- plans for existing systems.

The city may also have plans for future construction or replacement of sanitary sewer and other utilities.

The United States Army Corps of Engineers may provide

- flood studies,
- levee construction plans,
- flood control plans,
- other information about flood plains and flood control areas.

Finally, the designer should conduct a field review of the project to become familiar with the area and any special drainage problems that may exist. The survey drainage plats will show drainage areas for the existing system. Refer to these drainage areas when deciding on the locations and sizes of intakes in the proposed drainage system. However, be aware that the drainage areas will change to accommodate the new intake locations.

Storm Sewer Design Standards

Table 1: General

	English	metric
minimum pipe size	15 in*	375 mm*
minimum velocity of flow	3 ft/s	0.9m/s
maximum velocity of flow	15 ft/s	4.5 m/s

*The FHWA requires a minimum 24-inch (600 mm) pipe under all pavement on the National Highway System (NHS).

Table 2: Manning "n" (Manning's Equation)

concrete pipe	0.013
vitrified clay	0.013
corrugated metal	0.024
paved invert	0.021
fully lined	0.013
ductile iron	0.013
cast iron	0.013

Table 3: Recurrence Intervals

section of storm sewer/situation	recurrence interval (design frequency)
intakes and spread on primary highways and city streets	2 year storm
intakes and spread on freeways and interstate highways	10 year storm
small storm sewer (lateral and branch lines)	10 year storm
large storm sewer (48 inches or larger)	25 year storm
subways, sag vertical curves, and high liability areas	50 year storm
depressed freeway sections	50 year storm
major storm checks	100 year storm

Table 4: Maximum Spacing of Intakes and Utility Accesses

English		metric	
pipe diamter	maximum spacing	pipe diameter	maximum spacing
15 in	400 ft	375 mm	120 m
18–30 in	500 ft	450-750 mm	150 m
36–42 in	700 ft	900-1050 mm	210 m
≥ 48 in	1200 ft	≥ 1200 mm	360 m

Time of Concentration (T_c)

At least 5 minutes should be used for the time of concentration.